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(71) Applicant: **THOMAS & BETTS CORPORATION (a New Jersey Corporation)**
Memphis Tennessee 38119 (US)

(72) Inventors:
- **Teagno, Vladimiro**
  10137 Torino (IT)
- **Wells, Peter M., Jr.**
  Germantown, TN 38139 (US)

(74) Representative: **Tonon, Gilberto et al**
c/o Società Italiana Brevetti S.p.A.
Piazza di Pietra, 39
00186 Roma (IT)

(54) A self-locking cable tie strap with a symmetrical structure

(57) A cable tie strap for locking bundles of cables, of the self-locking type, comprising a hollow head (2) provided with a locking member (6)of the non-reversible type associated with a tail (3) provided with a toothing (7A, 7B) that can be inserted within said hollow head (2), said hollow head (2) being provided with symmetrical openings for the passage of said tail (3) provided with a toothing (7A, 7B); there being provided at the interior of said hollow head a flexible locking member(6) with an unidirectional action capable of cooperating with a first or a second toothing (7A, 7B) provided on said tail regardless of the direction of insertion of said tail (3) into one or the other of said symmetrical openings provided on the head (2).

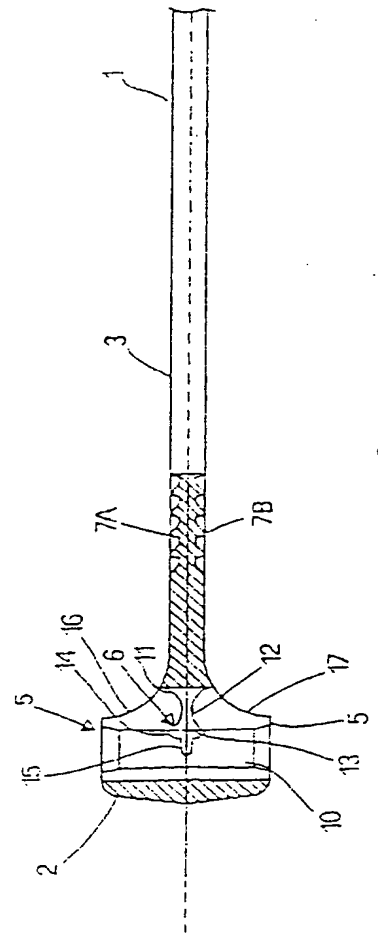


FIG.3

EP 0 759 523 A1

De cription

The present invention relates to a self-locking cable tie strap with symmetrical structure.

In the state of the art are well known self-locking cable tie straps for binding together in a bundle wires or cables for the realization of harnesses of any kind.

The cable tie straps according to the known art comprise a head part provided with a retaining tooth or pawl, sometimes realized with a metallic insert, arranged to cooperate with a flexible member integral with the head and provided with a toothing on one side arranged for engaging in an irreversible way the retain tooth or pawl at the moment of the fastening of the bundle of cables and wires. These tie straps according to the prior art have the tooth or pawl in the head that operate in an unidirectional way and are arranged to cooperate with the toothing on the flexible member or tail that is provided with toothing on one side only.

This known construction of the self-locking tie straps with an irreversible locking entails that owing to the asymmetrical structure of the same, at the moment of their application for the binding of cables or wires it is necessary to pay attention to the direction of insertion of the flexible member or tail to ensure correct engagement and locking with the head.

There are also known members for the temporary locking of electrical wires with a releasable locking with a symmetrical structure used for the temporary locking of electrical cords of electrical or electronic apparatus during the packaging, having a symmetrical structure that is however not suitable for assemblies of the industrial type and that do not show the capabilities of locking and safety of locking of the cable tie straps for industrial use mentioned above.

It is also to be remarked that in the cable tie straps for industrial use to which the present invention is mainly referred, the known asymmetrical structure does not show inconveniences when these straps are applied by hand: a minimum amount of attention on the part of the operator is sufficient.

However, in the case of binding machines of the industrial type, the asymmetry of the known cable tie straps entails several serious inconveniences. The cable tie straps according to the prior art owing to the asymmetry cause a partially free binding at the base of connection of the flexible part or tail with the head part. This free part at the base of the head assumes a more or less acute angle in relation to the pull exerted at the binding and related to the diameter of the cables, straining the material of the strap at the connection part with the head with possible development of nicks or breakage at the connection base.

The straps according to the prior art are provided as tapes to allow the feeding of the tapes to an automatic binding tool.

The asymmetrical shape of the straps according to the prior art fed from an auxiliary distributor is the main origin of jamming of the mechanism of the auxiliary distributor as well as of the binding tool and the feeding conduit, since the feeding method is based on a transfer of the strap along a closed path by fluid propulsion (compressed air). The orientation of the strap is consequently extremely important to ensure the receiving of the strap within the binding tool into a correct position.

In order to ensure the correct orientation, systems according to the prior art use a flexible tube having a square or rectangular cross section that reproduces the outline of the head of the strap and consequently the strap inserted into an auxiliary device of the distributor is "shot" along the piping by means of a jet of air, maintaining its orientation.

This method that seems correct became critical and causes inconveniences when there is impressed a torsion to the square section piping or when the piping itself is bent with a radius shorter than a given limit.

It is therefore an aim of the present invention to provide a strap in plastic material having a symmetrical shape for the binding of cable that allows the introduction of the flexible portion (tongue) through the head from both sides rendering easier in this way the orientation of the strip fed by a jet of air along a tubing.

The symmetry of the strap allows therefore its travel in a piping having a round cross section eliminating any problem of jamming along a path determining the orientation of the strip with a spontaneous rotation (+90°, -90°) at the entry of the binding tool.

It is another aim of the present invention to provide a symmetrical strap shaped as a hammer where the connection point of the flexible portion or tail, provided with toothing on both sides, to the head portion with openings on both sides, is radiused with a symmetrical radius eliminating the narrow angle open zone and possible cracks or breakage for tensile stress.

It is another aim of the present invention to provide a symmetrical strap where the binding locking is determined by a part internal to the head located on the same axis with the flexible part or tail and by an opposite retaining tooth where the internal portion assumes a correct locking angle owing to the insertion of the tongue through the head in a sense or the other and where when the tension has been impressed by elastic deformation of the tongue the opposite tooth engages further the opposite tooth.

Other aims, features and advantages of the cable tie strap according to the present invention will become clear from the following disclosure that shows exemplary and non limiting embodiments of the invention and from the figures of the attached drawings, wherein:

figure 1 shows a plan view of the self-locking cable tie strap having a symmetrical structure according to the present invention;

figure 2 shows a lateral view, partially sectioned of the cable tie strap of figure 1;

figure 2A shows an enlarged detail of the strap

shown in figure 2;
figure 3 shows an enlarged sectional view of the head part of the strap shown in figure 2;
figure 4 shows a partial view of what is shown in figure 3, in the operational condition;
figure 5 shows a sectional view of the locking arrangement of the cable tie strap in an operative condition of binding of a bundle of cables;
figures 6A, 6B, 6C and 6D show a second embodiment of the locking head of the cable tie strap according to the invention;
figure 7 shows a plan view of another embodiment of the self-locking cable tie strap having a symmetrical structure according to the present invention;
figure 8 shows a lateral view, partially sectioned of the cable tie strap of figure 7;
figure 8A shows an enlarged detail of the strap shown in figure 8;
figure 9 shows an enlarged sectional view of the head part of the strap shown in figure 8A;
figure 10 shows a partial view of what is shown in figure 9, in the operational condition;
figure 11 shows a sectional view of the locking arrangement of the cable tie strap in an operative condition of binding of a bundle of cables;
figures 12A, 12B, 12C and 12D show a further embodiment of the locking head of the cable tie strap according to the invention;
figure 13 shows a further embodiment of the self-locking cable tie strap having a symmetrical structure according to the present invention, in plan view;
figure 14 shows a sectional view of the cable tie strap if figure 13, taken along plane 14-14;
figure 14A is a partial view that shows the relationship of the parts of the tie strap of figures 13 and 14 in their operative condition;
figure 15 shows a yet another embodiment of the self-locking tie strap having a symmetrical structure according to the present invention, in plan view;
figure 16 shows a sectional view of the cable tie strap of figure 15, taken along plane 16-16;
figure 17 shows yet another embodiment of the self-locking tie strap having a doubly symmetrical structure according to the present invention, in plan view;
figure 18 shows a sectional view of the tie strap of figure 17, taken along plane 17-17;
figures 19 and 20 show a sectional view of a modified tail part for the above tie straps having an irreversible locking toothing and a reversible locking toothing in its terminal part.

With reference to the drawings and in particular to figures 1, 2, 2A, the cable ties strap shown as a whole in 1 comprises a symmetrical head part 2, shaped as a hammer and a tail part 3 ending in a tail end 4. As it will be better shown in the following, both the head 2, and the tail 3 have a mirror-like symmetrical structure, thanks to which the very end of the tail 4 of the strap 1 may be inserted within the locking cavity 5 of the head 2 either on the right side or on the left side, as it is shown by the arrows F1, F2 in figure 2. The locking action of the tongue 3 within the head 2 is performed by effect of the positive locking by a symmetrical tooth or pawl 6 that cooperates with a double sawtooth toothing 7A, 7B realized on both the larger sides of the tail 3. As it is usual, the tail end 4 of the strap 1 is without toothing and tapered to facilitate its insertion into the head 2 of the strap 1 in the initial steps of the locking operations of a bundle of cables or conductors.

In a preferred embodiment, the connection part 8, 9 is radiused with a radius R for a better distribution of the bending stresses at the moment of locking of the strap on a bundle of cables and for preventing its breakage near the head owing to large stresses that may occur, as mentioned above, at the moment of fastening, or during the useful life of the strap in the operative conditions.

With reference to figures 3 and 4 there will be shown with more details the strap according to the invention. Reference numbers equal to those of figures 1 and 2 show corresponding parts.

The symmetrical head 2 comprises a channel 10 with symmetrical entry openings 5, for the passage of the tail 3. At the interior of the channel 10 there is provided a ridge for the positioning of the toothing 7A, 7B of the tongue 3, and a tab or movable retaining tooth or pawl 6 on a virtual hinge comprising a root 11 radiused to the body of the head 2, a thinned part 12 with two shoulders 13 and 14, and a locking tooth proper 15.

During the locking operation, the whole of the retaining tooth 6 may rotate either in a clockwise or counterclockwise direction with respect to the rest position shown in figure 3 according to the direction of introduction of the tongue 3 within the cavity provided in the head 2.

The parts 16, 17 of connection of the head 2 with the tail 3 are radiused for decreasing the stresses as described above.

In figure 4 there is shown the structure of figure 3 in one of the two possible locking conditions. For simplicity of disclosure, there is shown only one locking condition; the other locking condition is mirror-like symmetrical, owing to the symmetry of the locking structure according to the invention, i.e., it is a simple mirror image that will not be disclosed in detail.

In this figure 4, the cable tie strap is shown in a locking condition in which the retaining tooth 6 is shown in the direction of the introduction of the tail 3 in direction shown by the arrow F3. An introduction of the tail 3, with the symmetrical toothing 7A, 7B causes the retaining of the retaining tooth 6 that prevents the extraction of the tail 3.

The radiused parts 16, 17 on centers C1, C2 allow, as stated above, the structure to be rendered more rugged, and also allow a better mating with the cables of the bundle, one of which is shown in 20. The assembly

situation is shown in figure 5 and a further explanation is deemed unnecessary.

In figures 6A to 6D there is shown a second embodiment of the present invention, relating to the head 2. Since the modification shown in figures 6A-6D relates only to the locking tooth or pawl 6, there will be disclosed in detail only the structure of the latter, leaving out the remainder of the head 2, which is identical to what has been disclosed hereinbefore.

For a better understanding of the modifications according to figures 6A-6D, it is advisable to mention a problem that appears with the conventional cable tie straps and also in those described above.

When the cable tie strap has been locked, the strength necessary for the locking is concentrated, in practice, in the virtual hinge part 6 (figure 3). This part 6 cannot be too strong, otherwise the introduction and locking operation for the strap would be difficult. At the same time it cannot be to yielding, otherwise the quantity of material that has strength in the fastening step would be insufficient. The structure and dimensioning of part 6 constitutes therefore a critical element in the design and production of this kind of cable tie straps.

The structure shown in figures 6A-6D enables this problem to be overcome.

As it is shown in these figures, the locking tooth 6' comprises a root part 20 connected with an elastic hinge 21 to a locking body proper shaped as a symmetrical polygonal star. This locking body comprises shapings 22, 22'; 23, 23'; 24, 24'. As it is shown in figure 6B, during the insertion operation of the tongue within the head 2, the body 6' rotates to the left allowing the passage of the tongue 3 and of the tooth 7A. In this connection, owing to the flexibility of the elastic or virtual hinge 21, the shapings 23', 24' will be carried outside the outline of the tooth 7A, allowing the introduction of the tongue 3 in the direction shown by the arrow F4.

In the condition of simple engagement, the tail 6 will have two teeth 7A', 7A", in engagement with the shapings 24' and 23' (see figures 6A and 6C). In this way the positioning is much more stable with respect to the conventional construction.

In condition of finished fastening and/or particular stresses when the cable tie strap is in the operational condition, stressed by the force indicated by the arrow F5, the locking tooth 6' will be in engagement with the shapings 24', 23' with the tooth 7A', 7A", but owing to the yielding of the elastic hinge 21 the shaping 22 will rest against the left part of the root 20. In this way the strength to the tear of the tail 6' will be assured not by the hinge 21 as in the conventional construction, but by the interlocking of the shapings 24, 23', to teeth 7A', 7A", shaping 22 and root 20. Consequently the strength to the tear will be guaranteed by the strength of the tongue 6 and not by the hinge 21 with an increase of reliability of the binding extremely higher than that of the conventional cable tie straps.

It will be clear that the construction and the operational principle of the construction according to figures 6A-6D may also be applied to asymmetrical cable tie straps of the conventional kind.

With reference to the drawings and in particular to figures 7, 8, 8A, the cable ties strap shown as a whole in 101 comprises a symmetrical head part 102, shaped as a hammer and a tail part 103 ending in a tail end 104. As it will be better shown in the following, both the head 102, and the tail 103 have a mirror-like symmetrical structure, thanks to which the tail end 104 of the strap 101 may be inserted within the locking cavity 105 of the head 102 either on the right side or on the left side, as it is shown by the arrows F1, F2 in figure 8. The locking action of the tongue 103 within the head 102 is performed by effect of the positive locking by a symmetrical tooth or pawl 106 that cooperates with a double sawtooth toothing 107A, 107B realized on both the larger sides of the tail 103. As it is usual, the tail end 104 of the strap 101 is without toothing and tapered to facilitate its insertion into the head 102 of the strap 101 in the initial steps of the locking operations of a bundle of cables or conductors.

In a preferred embodiment, the connection part 108, 109 is radiused with a radius R for a better distribution of the bending stresses at the moment of locking of the strap on a bundle of cables and for preventing its breakage near the head owing to large stresses that may occur, as mentioned above, at the moment of fastening, or during the useful life of the strap in the operative conditions.

With reference to figures 9 and 10 there will be shown with more details the strap according to the invention. Reference numbers equal to those of figures 7 and 8 show corresponding parts.

The symmetrical head 102 comprises a channel 110 with symmetrical entry openings 105, for the passage of the tail 103. At the interior of the channel 110 there is provided a ridge for the positioning of the toothing 107A, 107B of the tongue 103, and a tab or movable retaining tooth or pawl 106 on a virtual hinge comprising a root 111 radiused to the body of the head 102, a thinned part 112 with two shoulders 113 and 114, and a locking tooth proper 115. In addition there is provided a positioning tooth T located substantially opposite to the locking tooth 115.

During the locking operation, the whole of the retaining tooth 106 may rotate either in a clockwise or counterclockwise direction with respect to the rest position shown in figure 9 according to the direction of introduction of the tongue 103 within the cavity provided in the head 102.

The parts 116, 117 of connection of the head 102 with the tail 103 are radiused for decreasing the stresses as described above.

In figure 10 there is shown the structure of figure 9 in one of the two possible locking conditions. For simplicity of disclosure, there is shown only one locking condition; the other locking condition is mirror-like symmet-

rical, owing to the symmetry of the locking structure according to the invention, i.e., it is a simple mirror image that will not be disclosed in detail.

In this figure 10, the cable tie strap is shown in a locking condition in which the retaining tooth 106 is shown in the direction of the introduction of the tail 103 in direction shown by the arrow F3. An introduction of the tail 103, with the symmetrical toothing 107A, 107B causes the retaining of the retaining tooth 106 that prevents the extraction of the tail 103.

The radiused parts 116, 117 on centers C1, C2 allow, as stated above, the structure to be rendered more rugged, and also allow a better mating with the cables of the bundle, one of which is shown in 20. The assembly situation is shown in figure 5 and a further explanation is deemed unnecessary.

In figures 12A to 12D there is shown a second embodiment of the present invention, relating to the head 102. Since the modification shown in figures 12A-12D relates only to the locking tooth or pawl 106, there will be disclosed in detail only the structure of the latter, leaving out the remainder of the head 102, which is identical to what has been disclosed hereinbefore.

For a better understanding of the modifications according to figures 12A-12D, it is advisable to mention a problem that appears with the conventional cable tie straps and also in those described above.

When the cable tie strap has been locked, the strength necessary for the locking is concentrated, in practice, in the virtual hinge part 106 (figure 9). This part 106 cannot be too strong, otherwise the introduction and locking operation for the strap would be difficult. At the same time it cannot be to yielding, otherwise the quantity of material that has strength in the fastening step would be insufficient. The structure and dimensioning of part 106 constitutes therefore a critical element in the design and production of this kind of cable tie straps.

The structure shown in figures 12A-12D enables this problem to be overcome.

As it is shown in these figures, the locking tooth 106' comprises a root part 120 connected with an elastic hinge 121 to a locking body proper shaped as a symmetrical polygonal star. This locking body comprises shapings 122, 122'; 123, 123'; 124, 124'. As it is shown in figure 12B, during the insertion operation of the tongue within the head 102, the body 106' rotates to the left allowing the passage of the tongue 103 and of the tooth 107A. In this connection, owing to the flexibility of the elastic or virtual hinge 121, the shapings 123', 124' will be carried outside the outline of the tooth 107A, allowing the introduction of the tongue 103 in the direction shown by the arrow F4.

In the condition of simple engagement, the tail 106 will have two teeth 107A', 107A", in engagement with the shapings 124' and 123' (see figures 12A and 12C). In this way the positioning is much more stable with respect to the conventional construction.

In condition of finished fastening and/or particular stresses when the cable tie strap is in the operational condition, stressed by the force indicated by the arrow F5, the locking tooth 106' will be in engagement with th shapings 124', 123' with the tooth 107A', 107A", but owing to the yielding of the elastic hinge 121 the shaping 122 will rest against the left part of the root 120. In this way the strength to the tear of the tail 106' will be assured not by the hinge 121 as in the conventional construction, but by the interlocking of the shapings 124, 123', to teeth 107A', 107A", shaping 122 and root 120. Consequently the strength to the tear will be guaranteed by the strength of the tongue 106 -and not by the hinge 121 with an increase of reliability of the binding extremely higher than that of the conventional cable tie straps.

It will be clear that the construction and the operational principle of the construction according to figures 12A-12D may also be applied to asymmetrical cable tie straps of the conventional kind.

With reference to figures 13, 14 and 14A a further embodiment of the self-locking tie strap according to the present invention will now be disclosed.

The head 200 of this tie strap is somewhat similar to the one disclosed with reference to figures 6A to 6D. The head 200 comprises a head part 201 coupled with bars 202, 203 to a connection body 204 that supports a tongue or pawl 205 carried by a hinge stem HS. The tongue or pawl 205 is provided with pairs of symmetrical teeth 206, 207 and 206A, 207A, arranged to mate with a toothing 208, 208A, provided on the tail part 209 of the tie strap. The structure is designed so that the tongue or pawl 205 in the locked condition engages a pair of the teeth of the toothing 208, 208A depending on the direction of insertion of the tail 209 within the head 200. The general operation of the structure should be clear from the foregoing description and will not be repeated here.

With reference to figure 14A now the specific operation of the tie strap shown in figures 13 and 14 will be disclosed.

In figure 14A the same references quoted in figures 13 and 14 will indicate the same parts.

The tail part 209 inserted into the head 200 along the direction shown by the arrow F14 will bring the teeth 208 along the cavity defined in the head 200. The series of teeth 208A will engage the teeth 206, 207 of the tongue or pawl 205, if the tail part 209 is inserted along the direction of the arrow F14 (shown pointing to the left in figure 14A). The converse will occur with teeth 208 and the teeth 206A, 207A if the tail is inserted in a direction opposite to that of the arrow F14, i.e. from the left in figure 14A.

When a pull force schematically represented by the arrow P is exerted on the tail 209 caused by the binding force on a bundle of cables as previously disclosed, the hinge stem HS will undergo an elastic deformation so that two teeth of the series 208A will engage both the teeth 208 and 207 provided on the pawl 205. At the same time owing to the elastic yield of the hinge stem

HS, a part 205A will rest against the body of the head of the strap shown in 200A. In this way the force exerted by the pull force P will be distributed on three points (208A-206; 208A-207; 205A-200A), thus relieving any stress on the hinge stem HS that substantially in such condition performs the sole operation of keeping the parts 200, 208A, 205 in the correct position for an advantageous distribution of the forces in play.

In this way the hinge stem HS may be manufactured so that it is more elastically pliable. This fact proves advantageous when these tie straps are utilised with automatic insertion tools.

With reference now to figures 15 and 16, a further embodiment of the self-locking tie strap according to the present invention will be disclosed.

The head 300 of this tie strap is also similar to the one disclosed with reference to figures 6A to 6D. The head comprises a head part 301 coupled with bars 302, 303 to a connection body 304 that supports a tooth or pawl 305 carried by a hinge stem 306. The tooth or pawl 305 is provided with pairs of symmetrical teeth 306, 307 and 306A, 307A, arranged to mate with a toothing 308, 308A, provided on the tail part 309 of the tie strap. The structure is designed so that the tooth or pawl 305 in the locked condition engages a pair of the teeth of the toothing 308, 308A depending on the direction of insertion of the tail 309 within the head 300.

In this embodiment the hinge stem 306 is made relatively thin in order to reduce the insertion force for the tail 309 within the head 300. The stresses due to the binding action are counteracted by ridges 310, 311 and 310A, 311A that rest one against the other relieving from excessive stresses the hinge stem 306.

With reference now to figures 17 and 18, a further embodiment of the self-locking tie strap according to the present invention will be disclosed, and that has a head with a doubly symmetrical structure.

The head 400 comprises a head part 401 coupled with bars 402, 403 to a connection body 404. Both the head part 401 and the connection body 404 each support a tongue or pawl 405, 405A, respectively, carried by hinge stems 406, 406A. The teeth provided on the pawls 405, 405A are arranged to engage in the locked condition with a tooth on each side of the toothings 408, 408A provided on the tail part 409 regardless of the direction of insertion of the tail 409 within the head 400.

In this way there is a symmetry of operation insofar as the insertion of the tail into the head is concerned and also a symmetrical distribution of the stresses due to the binding action when the tie strap is in the operative condition. The same considerations above discussed with reference to figure 14A will be valid for this embodiment and a further discussion is considered not necessary.

Now, with reference to figures 19 and 20 a modified tail part convenient for use in the above tie straps will be disclosed.

As it is well known to a person skilled in the art, when tie straps of the type in question are used, often the operator encircles a bundle of cables or wires witha tie strap in a slack condition and subsequently performs the tightening of the tie straps in the desired position along the bundle.

With the irreversible lock tie straps known in the art, an extra tie strap too many, even if placed in a slack condition, cannot be removed if considered unnecessary. owing to the irreversible mechanism due to the cooperation between locking pawl and toothing on the tail. An unnecessary tie strap can only be removed by cutting it and throwing it away as scrap with a loss of money.

The tail for tie straps shown in figures 19 and 20 allows a preliminary releasable (non-irreversible) placement of the tie straps when these are not completely tightened in order to remove any unnecessary tie strap permitting that the same be reused for another strapping of cables of wires.

The tail part shown in figures 19 and 20, shown generally in 500, comprises a first part 501 adjacent to the head of the tie strap (not shown) and a second part 502 adjacent to the very end 503 of the tail.

The first part 501 is provided on both sides with toothings 504, 504A that engage irreversibly with the pawl or pawls provided in the head of the tie strap, and with a number of gently sloped teeth 505, 505A on the part 502. The slope at the left in figure 20 is such that an irreversible locking does not occur and the partially inserted or slack part of the tail may be removed, if necessary, from the head of the tie strap.

Further, the very end 503 of the tail 500 is provided with a taper 506 to facilitate the insertion of the end 503 of the tail 500 into the gap on the head of the tie strap, gradually overcoming the elasticity of the relatively stiff pawl or pawls.

Claims

1. A cable tie strap for locking bundles of cables, of the self-locking type, comprising a hollow head provided with a locking member of the non-reversible type associated with a tail provided with a toothing that can be inserted within said hollow head, characterized in that said hollow head is provided with symmetrical openings for the passage of said tail provided with a toothing; there being provided at the interior of said hollow head a flexible locking member with an unidirectional action capable of cooperating with a first or a second toothing provided on said tail regardless of the direction of insertion of said tongue into one or the other of said symmetrical openings.

2. A cable tie strap according to claim 1, characterized in that said tail has a substantially flat shape in section, and is provided symmetrically with a first and a second toothing on its wide surfaces, with a mirror-like symmetry.

3. A cable tie strap according to claim 1 or 2, characterized in that said hollow head has a passage for said tail, having located centrally within said passage a locking tooth member integral with a virtual hinge, the arrangement of said locking tooth and said virtual hinge being such that said tooth can be flexed in the direction of insertion of said tongue concurrently with the insertion direction of the free end of said tongue into one or the other of the openings of said hollow head at the moment of applying said tie strap for locking a bundle of cables or wires.

4. A cable tie strap according to one or more of the preceding claims, characterized in that said locking tooth, said virtual hinge and said tongue are integrally realized with a single molding operation.

5. A cable tie strap according to claim 4, characterized in that the connection parts between said head and said tail are symmetrically radiused.

6. A cable tie strap according to one or more of the preceding claims, characterized in that said locking tooth has a symmetrical structure with a protrusion arranged for engaging one or the other of said toothings on said tail according to the direction of insertion of said tail into s aid hollow head.

7. A cable tie strap according to one or more of claims 1 to 5, characterized in that said locking tooth has a symmetrical shape with a plurality of shapings, said shapings being arranged so that a pair of them engages at least a pair of teeth of said toothing on said tail, and at the same time another of said shapings engages the base of said virtual hinge; the arrangement being such that the pull stresses on said tail operate exclusively between said at least two teeth and said pair of shapings while the further shaping engages the body of said hollow head in an area at the base of said virtual hinge so that said virtual hinge is not stressed by the locking force.

8. A cable tie strap for locking bundles of cables, according to one or more of the preceding claims, characterized in that there is provided a fixed tooth within said hollow head in a location opposite to that of said flexible locking member so that in cooperation with said flexible member a positive locking action is provided on both toothings of said tongue when the cable tie strap is fastened on a bundle of cables.

9. A cable tie strap according to one or more of the preceding claims characterized in that said locking tooth or pawl has a symmetrical structure comprising a pair of locking members symmetrically arranged on one and the other side of said hinge locking tooth or pawl, and that the hinge member of said locking tooth or pawl is relatively elastically pliable; the arrangement being such so that in the locked condition a pair of locking teeth provided on said tail part engages both the locking members on one side of said hinged locking tooth, and at the same time the body of said hinged locking tooth rests against the internal body of the head of the tie strap, whereby the pull force when the tie strap is tied operates on the pair of locking members of said hinged locking tooth or pawl and a corresponding pair of the teeth on said tail, and on the body of said hinged locking tooth or pawl and the internal body of said head whereby the hinge member of said locking tooth or pawl is substantially free of stresses due to the pull deriving from the locked condition of the tie strap.

10. A cable tie strap according to claim 9, characterized in that the structure is symmetrical so that it can operate whatever is the direction of insertion of said tail into said head.

11. A cable tie strap for locking bundles of cables of the self-locking type comprising a hollow head provided with a locking arrangement associated with a tail provided with a toothing that can be inserted within said hollow head, characterized in that said hollow head is provided with symmetrical openings for the passage of said tail provided with a toothing; there being provided at the interior of said hollow head a locking arrangement constituted of a pair of flexible pawls in an opposed location capable of cooperating with both a first and a second toothing provided on said tail regardless of the direction of insertion of said tail into one or the other of said symmetrical openings.

12. A cable tie strap according to one or more of the preceding claims, characterized in that said tail comprises a first part adjacent to said head provided with a double toothing with teeth arranged for an irreversible coupling with said pawl or pawls; and a second part adjacent to the terminal end of said tail provided with a toothing comprising teeth arranged for a reversible coupling with said pawl or pawls whereby a tie strap may be temporarily placed on a bundle of cables or wires in a slackened condition that allows the removal of the tie strap without having to destroy it for its removal.

13. A cable tie strap according to claim 12, characterized in that the very end of said tail is provided with a tapering so that the initial insertion of said tail into said head may be performed without appreciable elastic deformation of said pawl or pawls, thus minimizing the insertion force of said tail into said head.

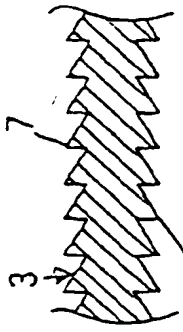


FIG.2A

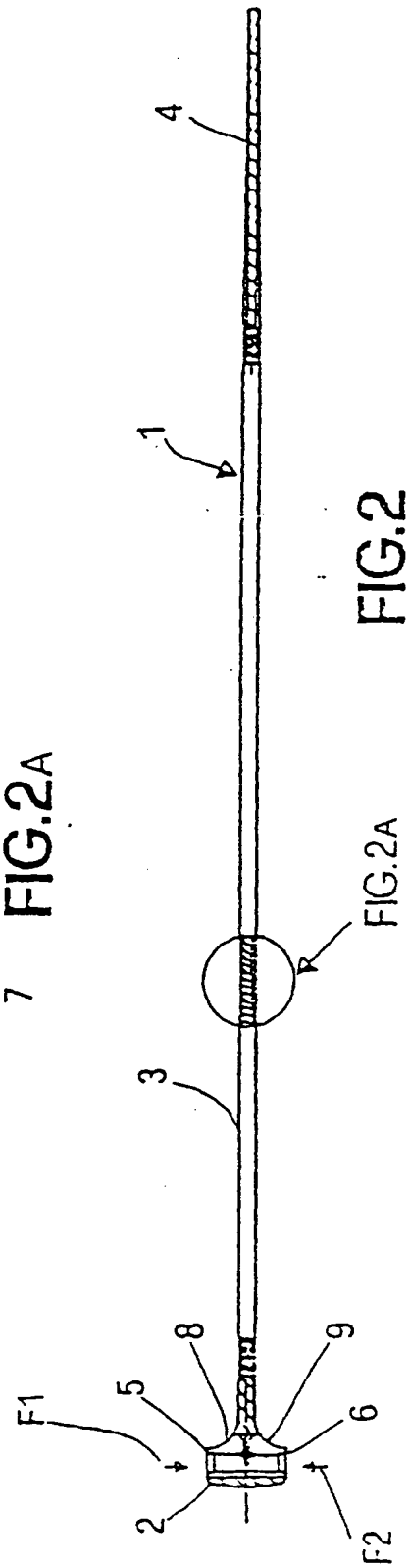


FIG.2

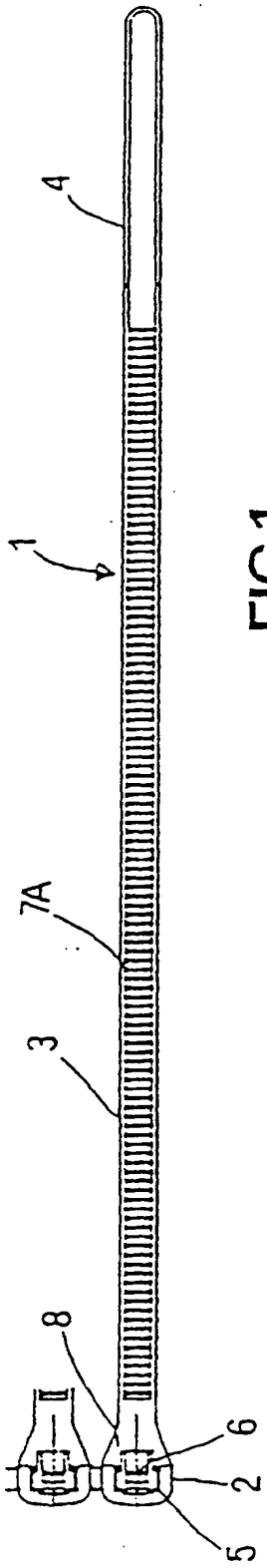


FIG.1

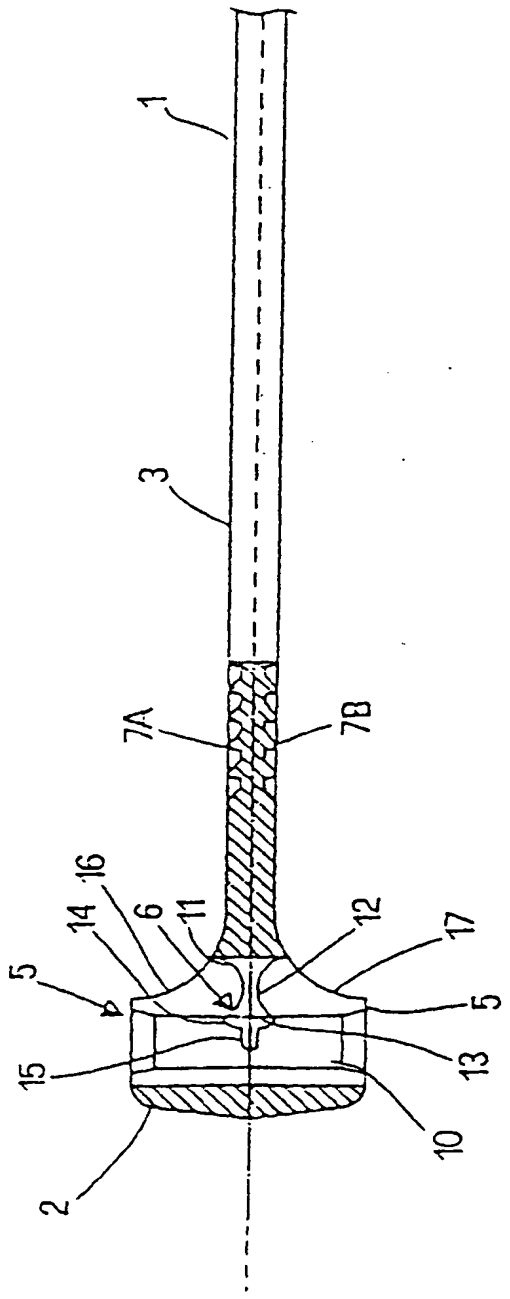


FIG.3

FIG.4

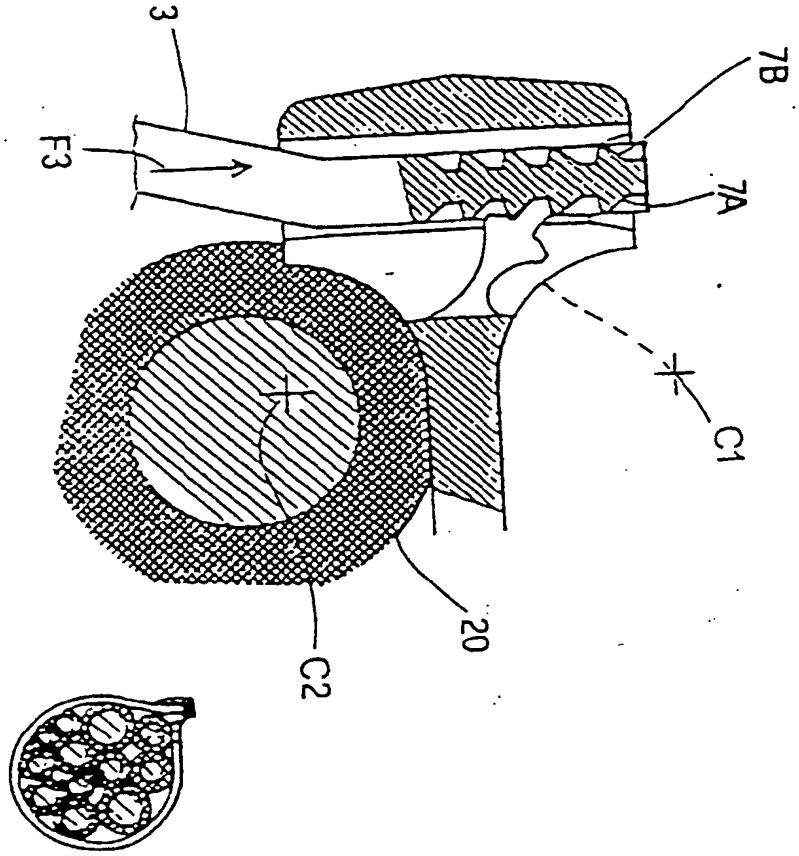


FIG.5

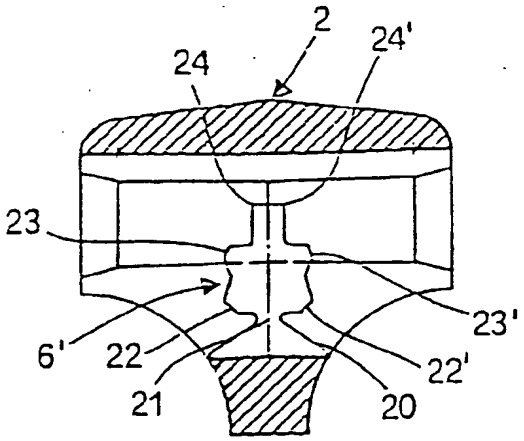


FIG.6A

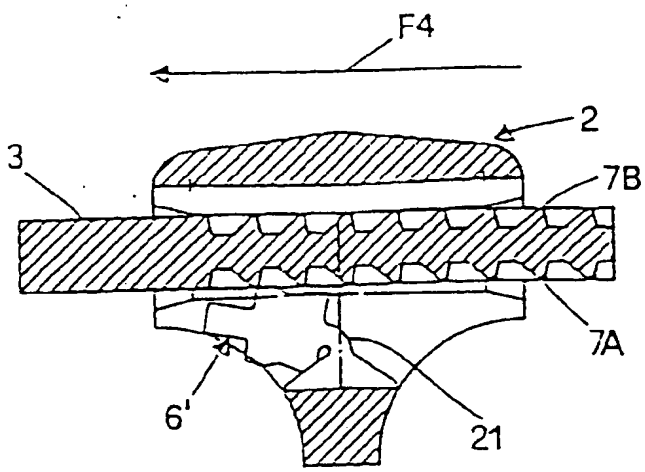


FIG.6B

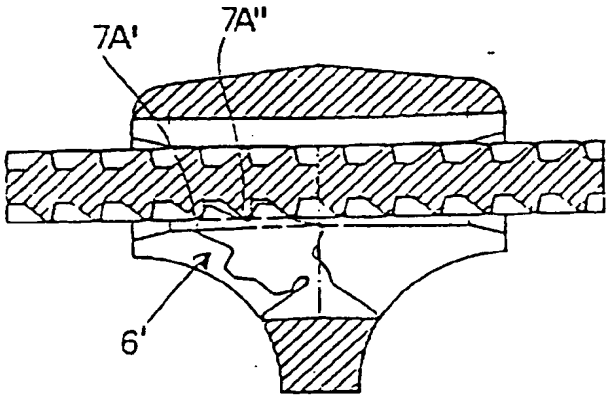


FIG.6C

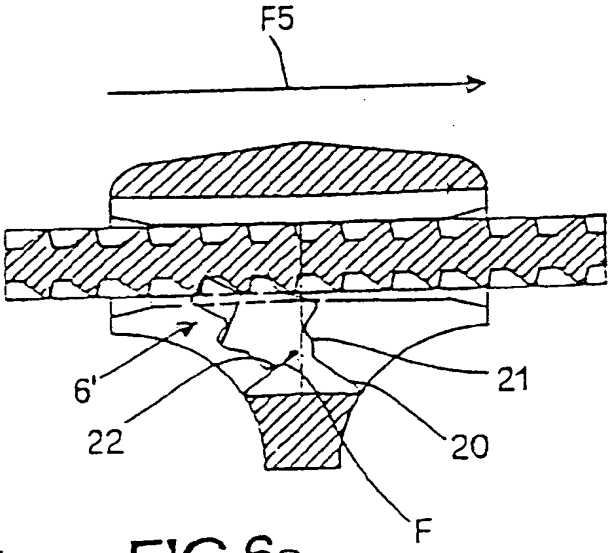


FIG.6D

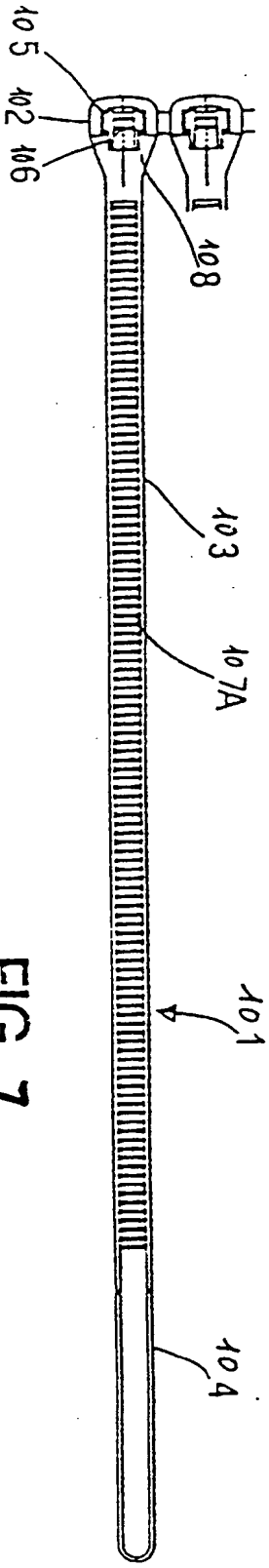


FIG. 7

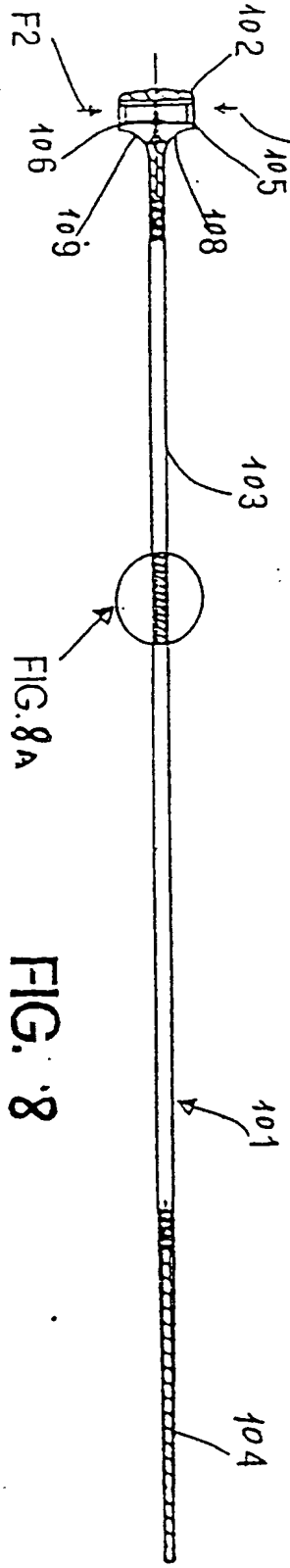
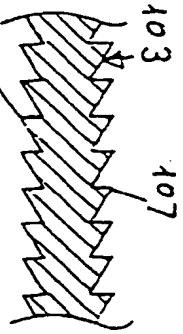


FIG. 8

FIG. 8A



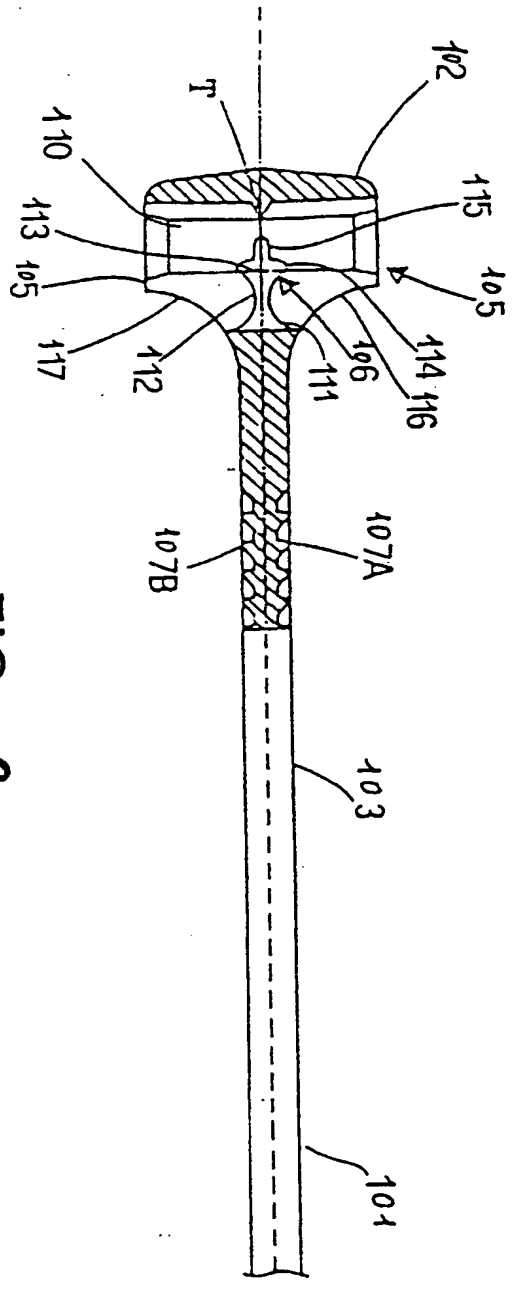


FIG. 9

FIG. 10

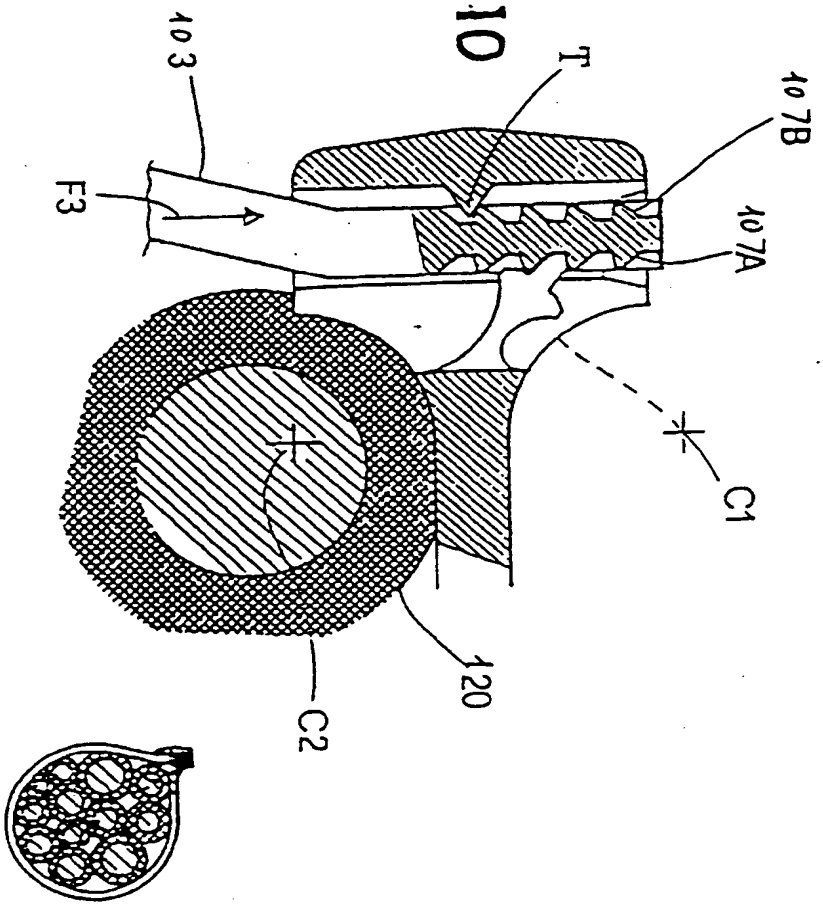


FIG. 11

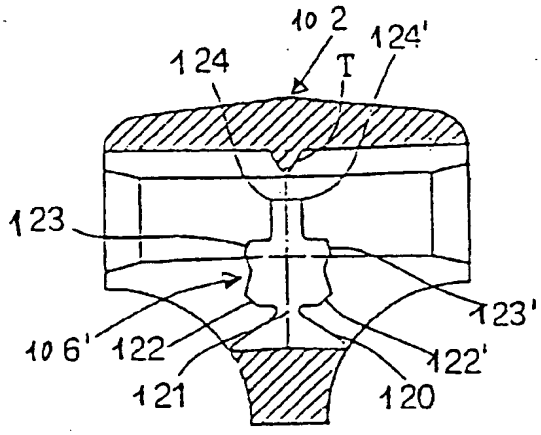


FIG.12 A

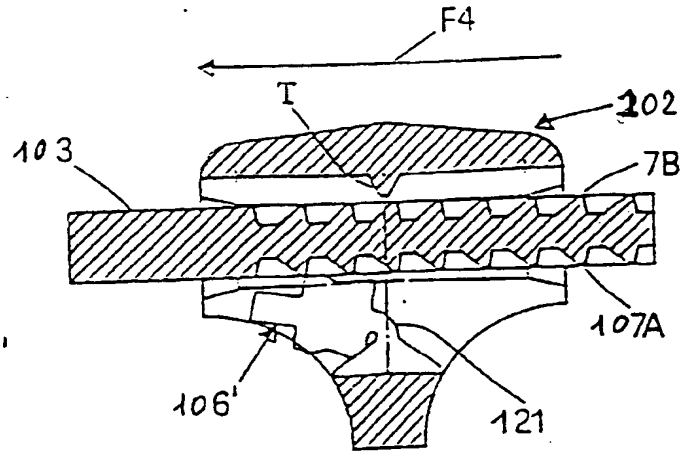


FIG.12 B

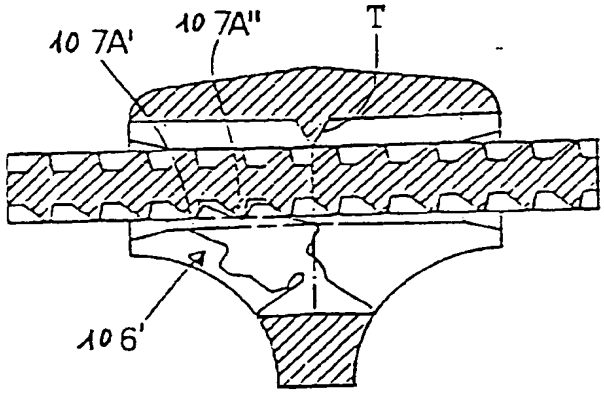


FIG.12 C

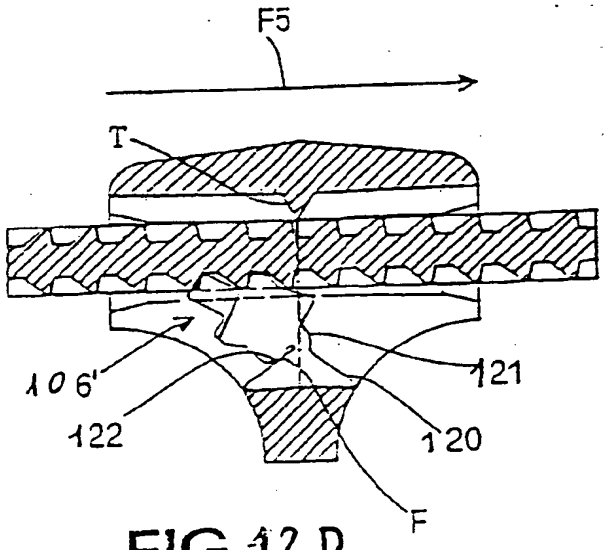


FIG.12 D

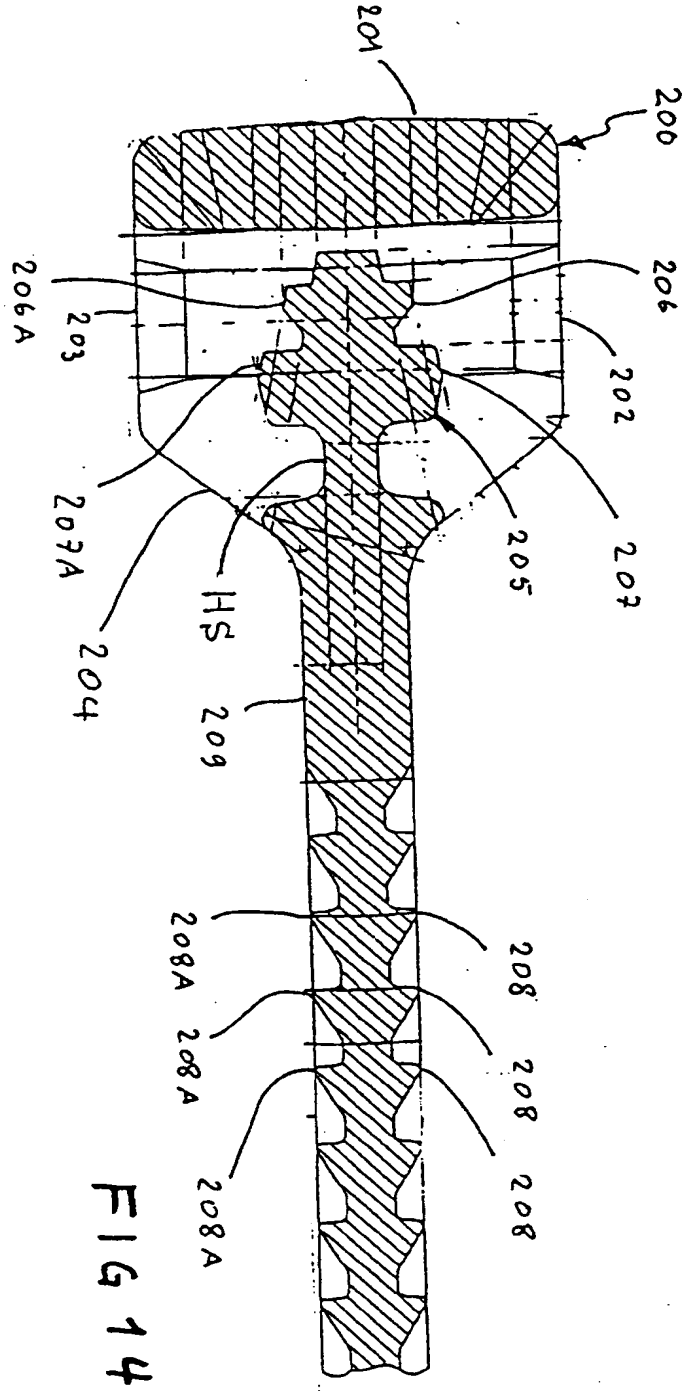


FIG 14

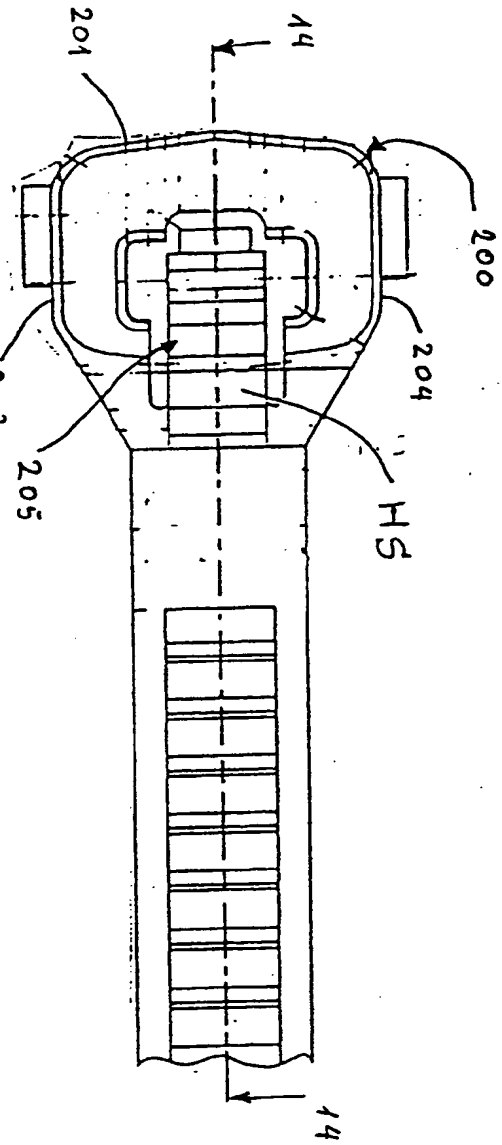


FIG 13

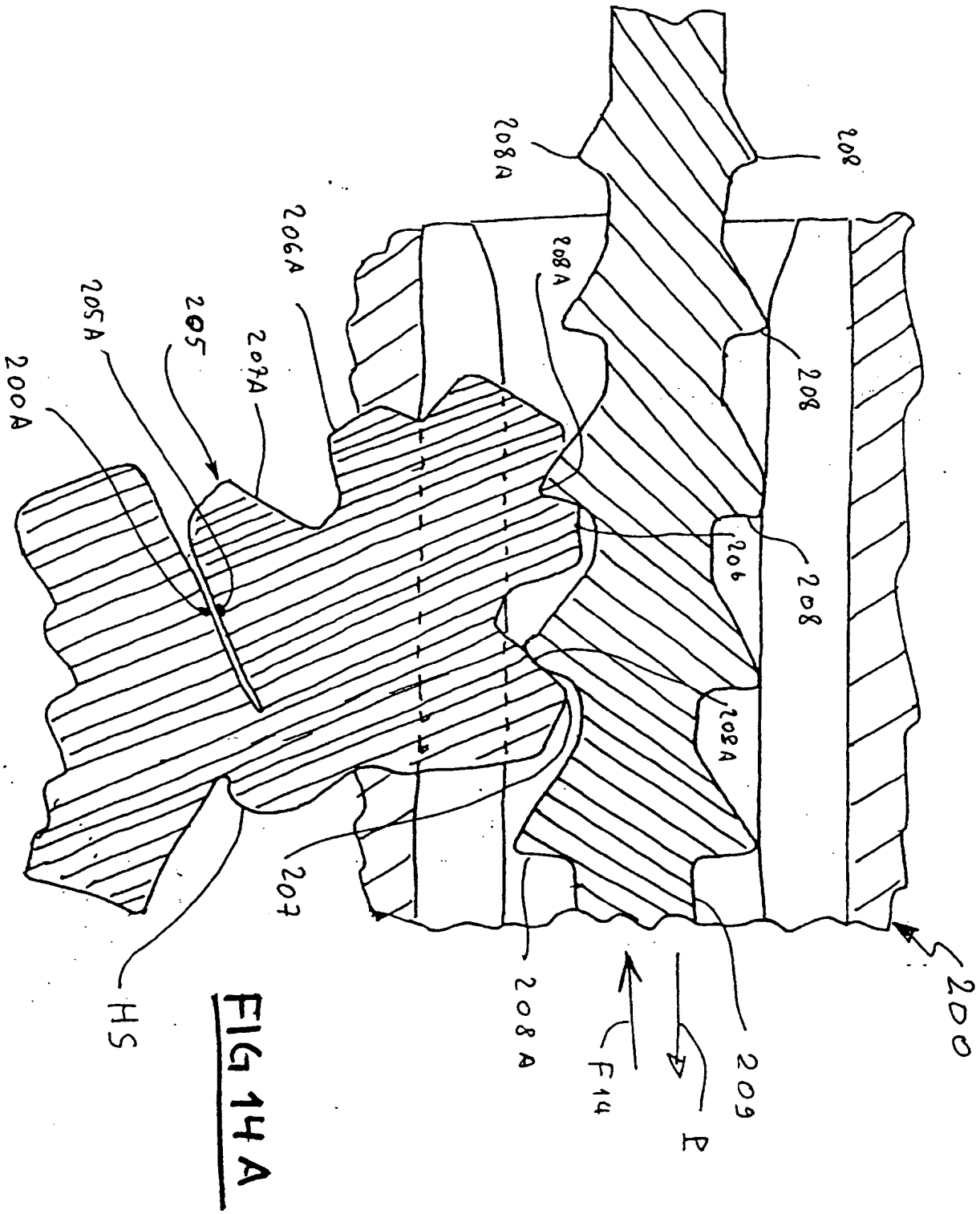


FIG 14A

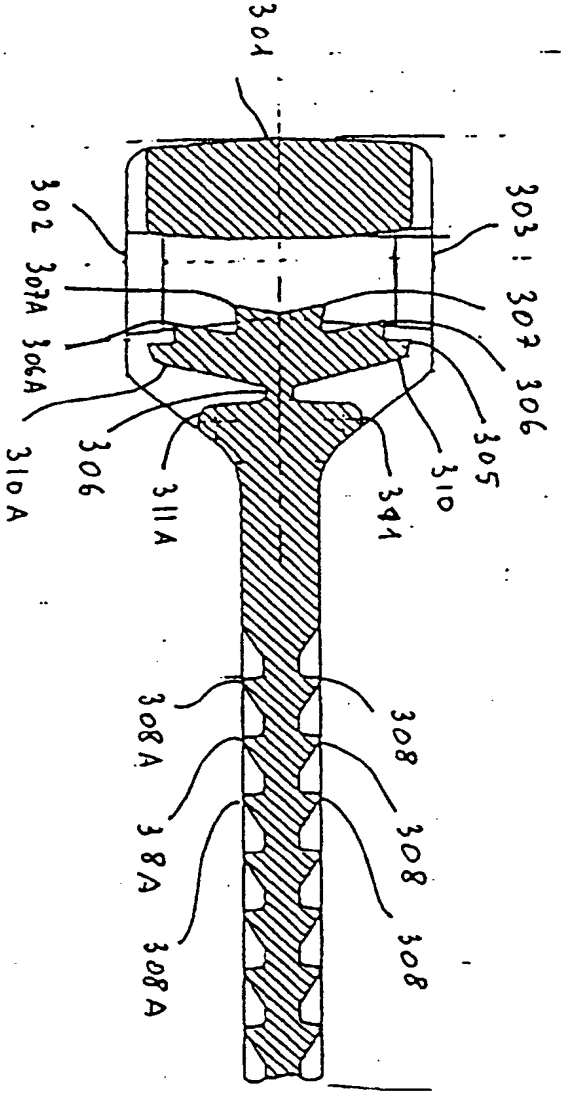


FIG 16

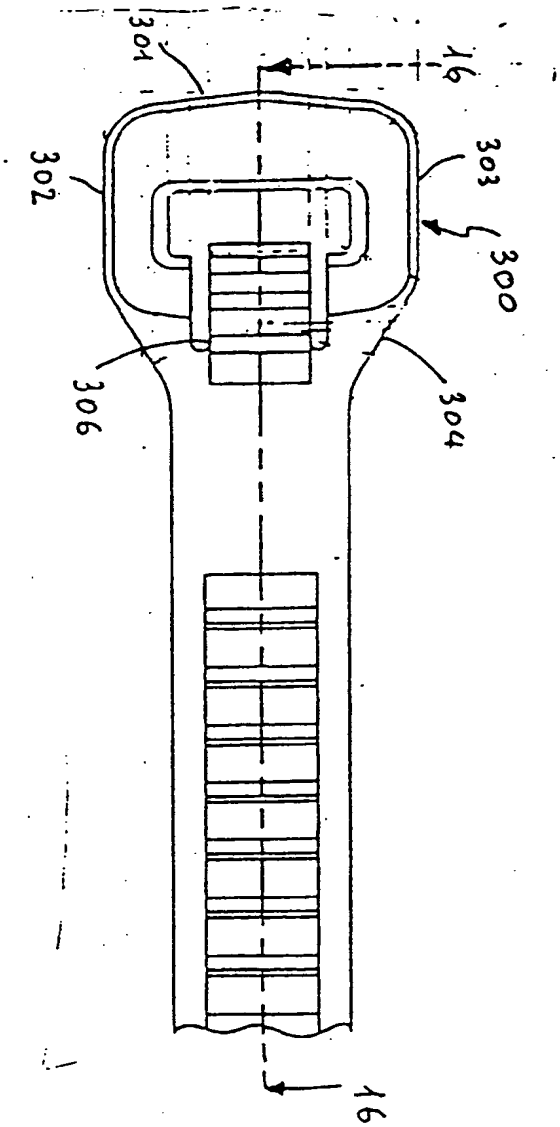


FIG 15

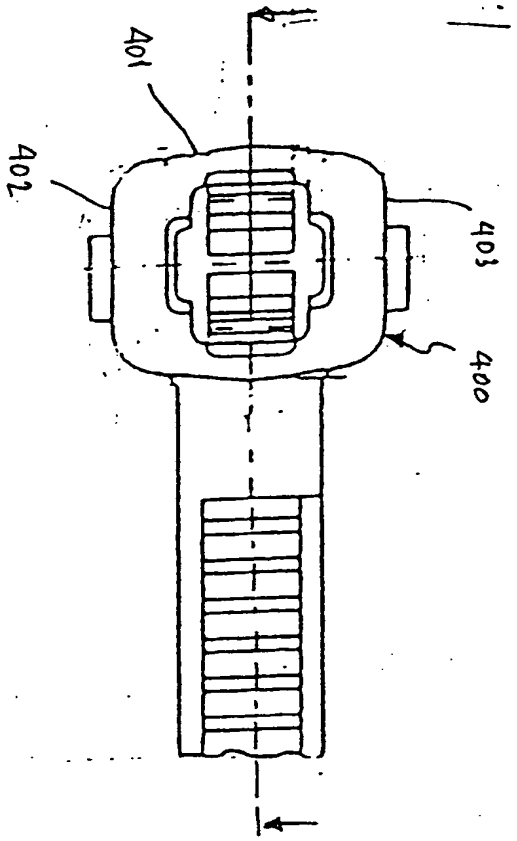


FIG 17

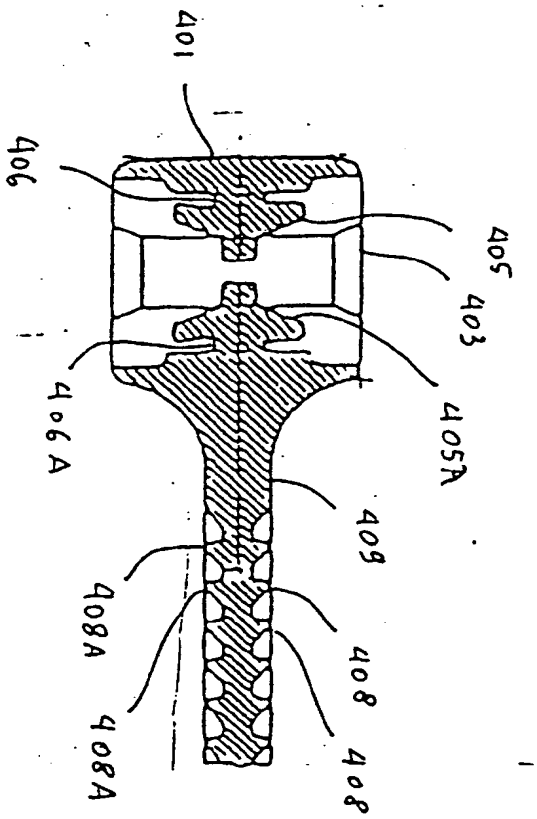


FIG 18

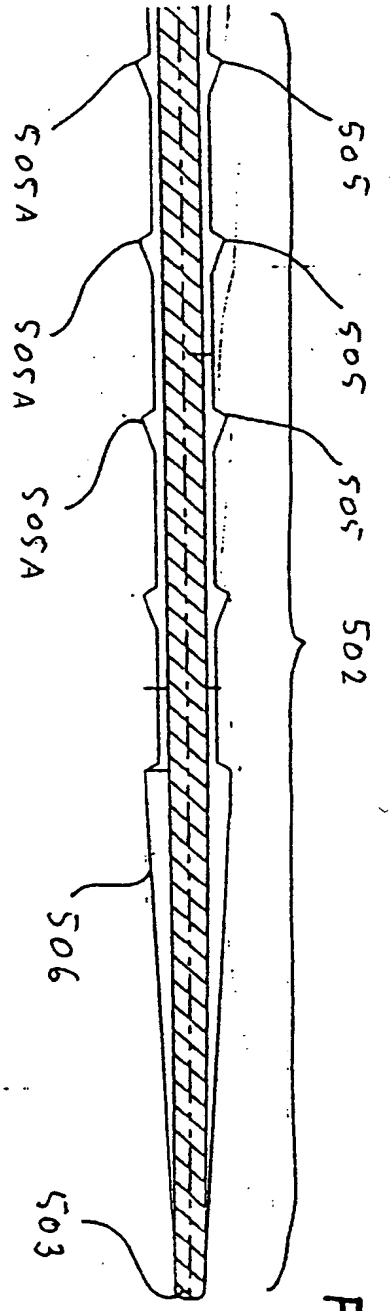


FIG 20

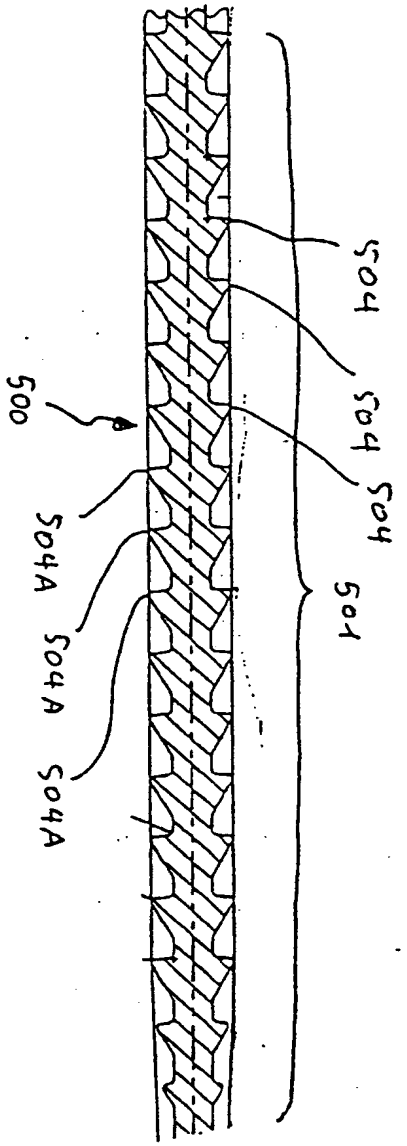


FIG 19

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0444

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-21 39 091 (SCHMITT, WALTER PETER, SARRE-UNION) * page 2, line 23 - line 34 * * page 3, line 27 - page 4, line 17 * * page 4, line 35 - line 40 * * page 5, line 8 - line 19 * * claims 1,3 * * figures 1,2 * ---	1-3,5,8, 11,12	F16L3/233
A	GB-A-1 383 912 (CRITCHLEY BROS. LIMITED) * page 1, line 89 - page 2, line 48 * * claim 1 * * figure 1 * ---	1,2,4,5, 7,11	
A	EP-A-0 611 038 (SORENSEN) * abstract * * column 1, line 52 - column 2, line 38 * * column 3, line 3 - line 35 * * claim 8 * * figures 2,4 * ---	1,3,4,8, 11,13	
A	FR-A-2 089 514 (THOMAS & BETTS CORPORATION) * page 2, line 12 - page 3, line 14 * * page 4, line 15 - line 32 * * page 6, line 4 - line 32 * * claims 1-4 * * figures 1,4,5,8,9 * --- -/--	1-3,11, 12	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
F16L
B65D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	15 October 1996	Schaeffler, C

CATEGORY OF CITED DOCUMENTS

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0444

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	WO-A-89 06328 (PANDUIT CORP.) * abstract * * page 2, line 18 - page 3, line 6 * * page 3, line 20 - page 4, line 20 * * page 5, line 22 - page 6, line 16 * * claims 1-3 * * figure 5 *	1,3,4,8, 11	
A	FR-A-2 082 115 (ÉTABLISSEMENTS CAILLAU) * page 1, line 33 - page 2, line 4 * * page 2, line 15 - line 38 * * page 3, line 8 - line 22 * * figures 1,5 *	1,2,7,9	
A	EP-A-0 469 908 (THOMAS & BETTS CORPORATION) * column 1, line 18 - line 36 * * column 3, line 37 - line 51 * * claims 1,4,7 * * figure 3 *	1,3,4,11	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	FR-A-2 302 435 (FIMO) * page 2, line 26 - line 38 * * page 3, line 9 - line 23 * * claim 1 * * figures 1-3 *	1,2	
A	US-A-3 102 311 (H.B.MARTIN ET AL.) * figures 1,5 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	15 October 1996	Schaeffler, C

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